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GB 1441208 A GB 1368665 A GB 1083185 A
GB 0790490 A GB 0234535 A EP 0059017 A
WO 88/08099 A1 WO 84/00798 A1

(58) Field of Search
UK CL (Edition L) F2G G37 , F2P PC15
INT CL[5] F16L

(54) Hydrotherm-thermal insulation for submarine pipelines and equipment

(57) This invention provides thermal insulation for underwater equipment, pipelines, valves, well christmas trees etc where the provision of thermal insulation is required to maintain fluid temperatures, thereby preventing adverse effects such as hydrate formation or wax deposition. A method of thermally insulating an underwater pipeline or group of pipelines 1, 2 is achieved by locating them within a surrounding elongate jacket 4, 5 formed of elastic material, being packed with ceramic microspheres 5A or other suitable material. A thickness of microspheres is appropriate to derive the required level of thermal insulation. The jacket 5 with cover 6 extend between end caps 7 secured to the pipe by adhesive. The caps 7 may be bonded to the jacket by adhesive or by co-curing the jacket and caps 7 to form an integral assembly. The void space around and between microspheres may be filled with a bonding material. Pipe 2 may be pre-coated with thermal insulation material and/or anti-corrosion material. The invention may be applied to a pipeline tee piece/branch connection and a valve assembly.

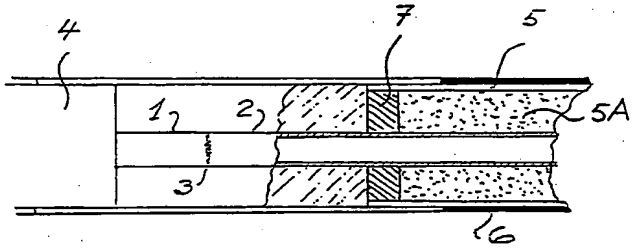

FIGURE 1A

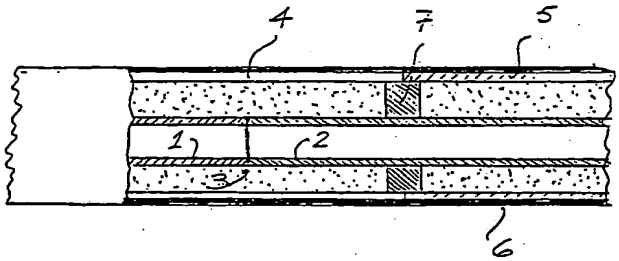

FIGURE 1B

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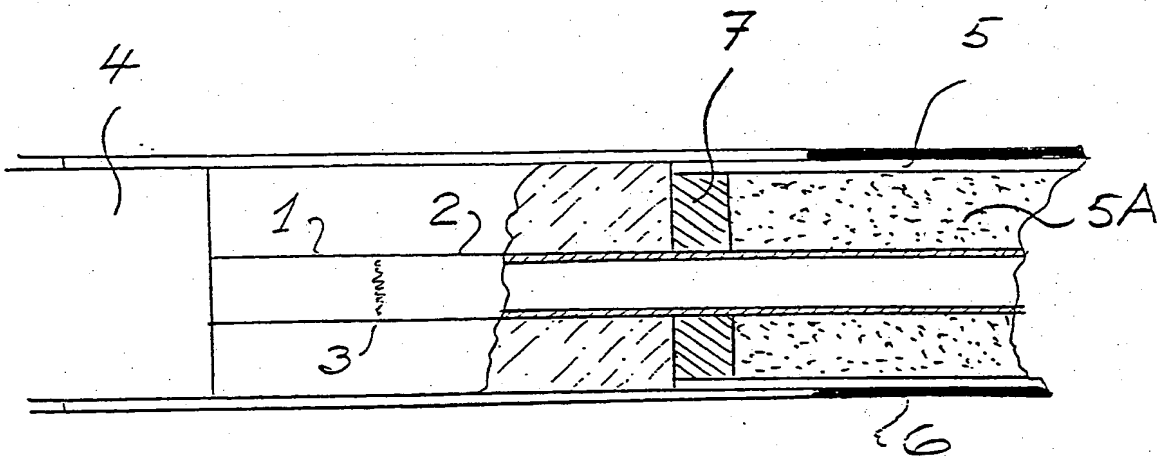

FIGURE 1A

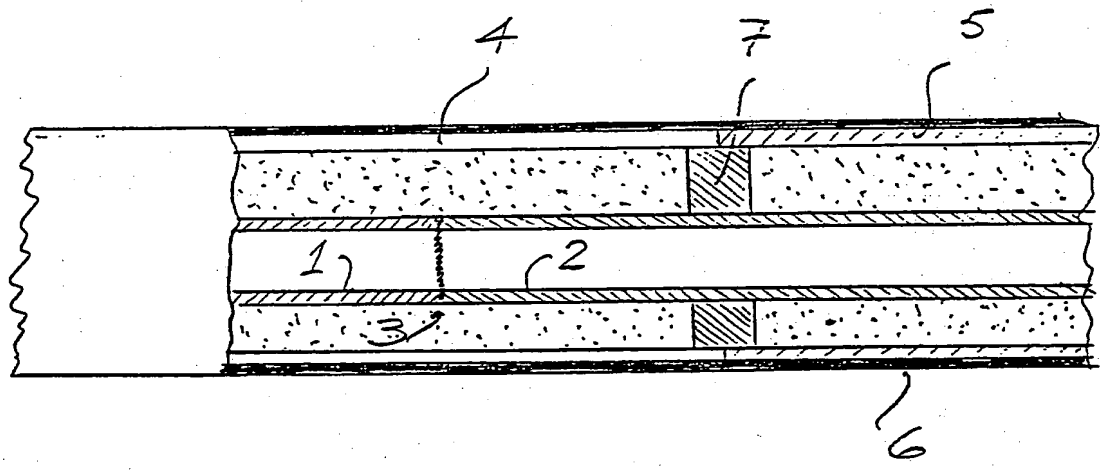

FIGURE 1B

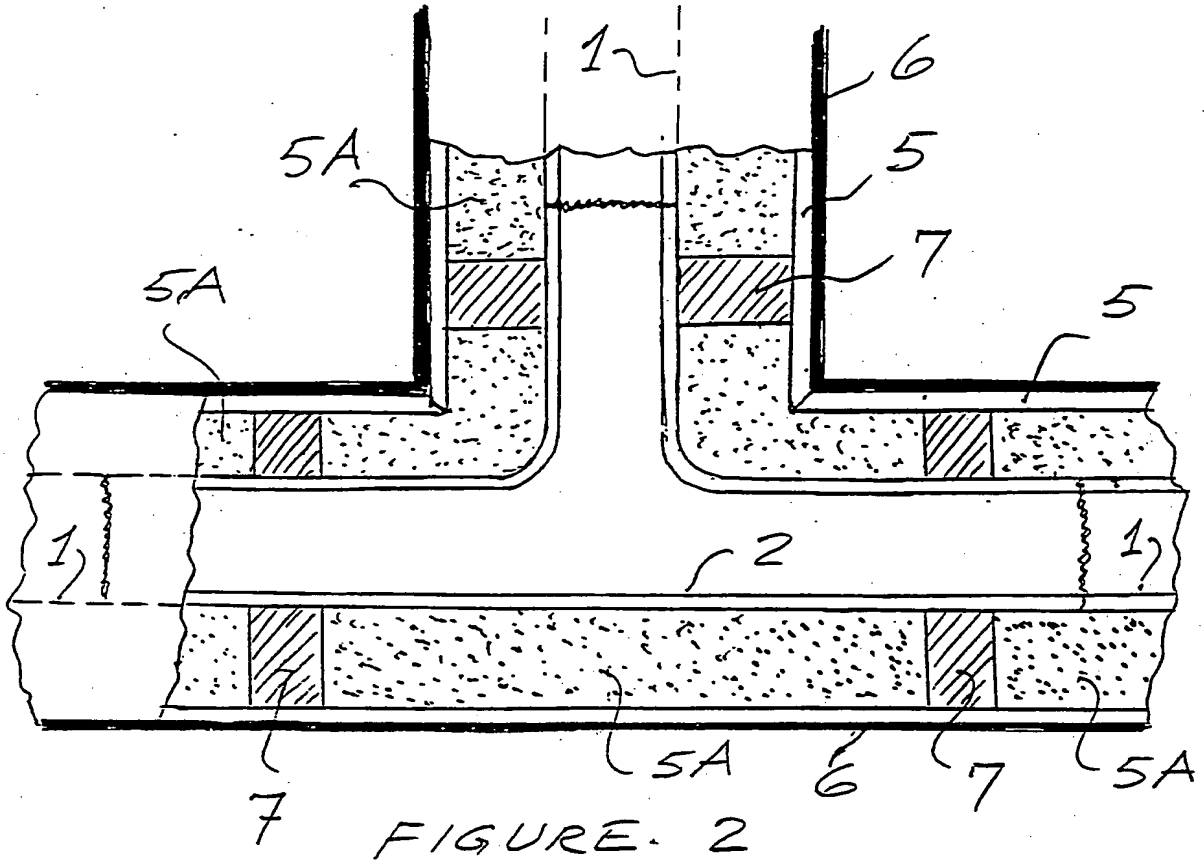

FIGURE. 2

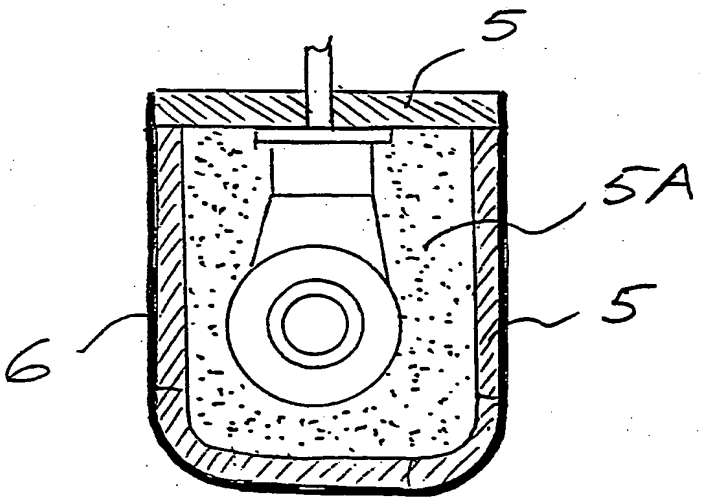

FIGURE 3

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PATENT APPLICATION

HYDROTHERM - THERMAL INSULATION FOR SUBMARINE PIPELINES AND EQUIPMENT

This invention relates to the provision of thermal insulation for underwater equipment, pipelines, valves, well xmas trees, as typical but not necessarily utilised in the recovery of offshore oil and gas, where the provision of thermal insulation is required to maintain fluid temperatures, thereby preventing adverse effects such as "Hydrate" formation or wax deposition.

The thermal insulation of submarine equipment such as pipelines, is achieved by the application to the external surface of the equipment suitable insulation material. The materials are applied by various processes including extrusion, impingement, wrapping and casting.

The principle of this invention is to provide thermal insulation, as an alternative to the methods described above, by locating around the equipment to be insulated a jacket, thereby forming a cavity around the equipment which is then filled with ceramic microspheres. The microspheres are hollow and when packed achieve a void volume ratio of 35%. If required the void space around and between the microspheres can be filled with a resin or other suitable bonding setting material. The jacket material can also

be chosen to further improve the acheivable thermal insulation.

To thermally insulate underwater equipment, typical pipelines, I provide as follows:

From a first aspect of the invention a method of deriving thermal insulation of equipment by locating around and enclosing the equipment in a jacket to form a cavity between the internal surfaces of the said jacket and the external surface of the equipment. The said cavity is then filled with hollow ceramic microspheres.

From a second aspect of the invention a method of deriving thermal insulation by locating a jacket and microspheres around and enclosing the equipment all as aforesaid, the void space around and between the microspheres then being filled with a resin, polymer or other suitable setting material.

For a third aspect of the invention a method of thermally insulating a pipeline or group of pipelines each comprising a plurality of pipes that are joined end to end, in which each pipe is located within a surrounding elongate jacket, each jacket terminating short of each end of the respective pipe and each end of each jacket being secured to an end cap which circumferentially surrounds and is secured to the respective pipes. Alternatively, the jacket may comprise a plurality of jacket sections, typically of length equal to

the pipe joint of which the pipeline or group of pipelines is formed. The sections of jacket may be abutted aand adjoined to each other and secured and secured at their ends to the end caps or bulkheads which circumfrentially surround and may be in turn secured to the pipeline or group of pipelines.

From a fourth aspect objects formed by the jacket, microspheres and fill material, all as aforesaid.

In order that the invention may be better understood specific embodiments thereof will now be described in more detail, by way of example only, with reference to the accompanying drawings.

Figure 1

A general illustration of a pipeline around which is fitted with a jacket to form a cavity filled with ceramic microspheres. The figure is in two parts, 1A and 1B.

Figure 2

A general illustration of a pipeline tee-piece or branch connection which is fitted with a jacket to form a cavity filled with ceramic microspheres.

Figure 3

A general illustration of a valve assembly which is fitted with a jacket to form a cavity filled with ceramic microspheres.

Referring to Figure 1A this shows two pipes 1, 2 of an underwater pipeline, the pipes being joined end-to-end by a welded connection 3. Each pipe is located within a surrounding elongate jacket 4, 5 respectively, the jackets terminating short of each end of the respective pipe. Alternatively, jacket 4 may be abutted and adjoined to jacket 5 following joining, typically welding of pipes 1 and 2 and application of corrosion protective wraps all as illustrated in figure 1B. The jackets are of similar construction and only that associated with the pipe 2 will be described in detail.

Thus, the jacket 5 with optional cover 6 may be of flexible material, extending between end caps 7 circumferentially surrounding the pipe 2. If desired, the end caps may be secured to the pipe by a suitable adhesive. The end caps may also be bonded to the jacket, either by adhesive or, by co-curing the jacket and the end caps to form an integral assembly. The space or cavity between the pipe 2 and the jacket 5, contains tightly packed microspheres or other suitable material 5A.

The void space around and between the microspheres may be filled with a bonding material, introduced as a liquid which then sets to form with the microspheres a consolidated material. Where the bonding material is to be introduced in the microsphere void space, the end caps 7 need only be temporary.

If desired pipe 2 may be pre-coated with thermal insulation material and/or anti-corrosion material which is also terminated short of each end of each respective pipe to facilitate joining 3.

A wide range of materials are suitable for the construction shown in figure 1. The jacket may be fabricated from suitable elastomeric material such as polyethylene, polyvinylchloride, polyolefines, glass reinforced resins, SBR and EPDM. The cover if required will also be preferably fabricated of a suitable elastomeric material such as SBR or EPDM. The jacket and cover should be effectively impermeable to the liquid with which the jacket is filled and the surrounding water when installed. The construction and thickness of the jacket and cover should be such as to avoid tearing, and may incorporate one or more layers of reinforcing material, or a wound wire or textile cord. Reinforcing ribs or slats may be incorporated to stiffen the cover. It is desirable however, that the cover has a low modulus in order that the jacket is elastic.

The end caps 7 are of a suitable rubber or plastic material such as SBR, EPDM, polythylene, polyvinylchloride, polyolefines, glass reinforced resins. When the pipe will be at high temperature is preferred to use heat-resistant material for at least the radially inner part of each end cap. The dimensions of the parts will be chosen to suit the anticipated pipe temperature. Heat-resistant material should be used until the temperature gradient from the inside to the outside of the end cap drops to typically below about 70 degree C.

The microspheres or other suitable material hereinafter referred to as microspheres, will have a bulk specific gravity less than that of water when tightly packed. Microspheres have a specific gravity of 0.7 and corresponding bulk density of 0.38 to 0.42 with a packing factor of 60-65%. The microspheres have a thermal conductivity of 0.09 to 0.11 W/M oK. Particle size of the microspheres range from 5-300 microns, but a particle size distribution can be selected as most appropriate for utilisation in the invention. When tightly packed the microspheres will prevent the collapse of the jacket 6 due to the hydrostatic pressure from the surrounding water. The microspheres themselves having collapse resistance beyond that to which they would be subjected by the surrounding water during installation.

Referring to illustration 2 and 3 demonstrating the invention as applied to a pipeline tee piece/branch connection and a valve assembly, the jacket will be fabricated to suit the shape and size as appropriate to the equipment for which it providing thermal insulation. Apart from the shape of the jacket all the materials and their fabrication are as aforesaid described for the pipe illustrated in Figure 1 and the same compartment reference numbers are adopted for clarity.

CLAIMS

1. A method of thermally insulating an underwater pipeline or group of pipelines by locating them within a surround elongate jacket formed of elastic material, being packed with ceramic microspheres or other suitable material. The thickness of microspheres being appropriate to derive the required level of thermal insulation.

2. A method according to claim 1 in which the jacket is of more rigid material or construction, typically steel,

3. A method according to claims 1 and 2 in which the said jacket is an elongate jacket extending from adjacent one end to adjacent the other end of the pipeline or pipeline assembly, where the pipelines comprise a plurality of pipes joined end to end, in which each pipe is located within a surrounding elongate jacket, each jacket terminating short of each end of the respective pipe and each end of each jacket being secured to an end cap which circumferentially surrounds the respective pipe, each jacket being tightly packed with microspheres. The gap between adjacent jackets being filled with other material or fitted with a cover filled with microspheres.

4. A method according to claims 1 to 3 in which said jacket comprises a plurality of elongate jackets which are abutted and adjoined to each other and if desired secured to bulkheads which circumferentially surround and if desired secured to the respective pipes.

5. A method according to claims 1 to 4 in which the said jacket comprises a plurality of elongate steel jackets which are joined to each other by welding.

6. A method according to claims 1 to 5 in which a layer of thermally insulating material surrounds said pipe and said microspheres are present between said thermally insulating material and the said jacket.

7. A method of thermally insulating an underwater irregular shaped component such as a tee piece, branch connection, valve, by locating within a jacket filled with microspheres all as aforesaid in claims 1 to 6.

8. A method according to claims 1 to 7 in which the void space around and between the microspheres is filled with a liquid which will solidify or set to bond together the microspheres and to derive mechanical properties of an elastomeric material. If desired the said end-caps may only be temporary and may be removed following filling of microsphere void space with bonding liquid.

9. A thermally insulated underwater pipeline or group of pipelines located within a surround elongate jacket formed of elastic material, being tightly packed with microspheres or other suitable material. The thickness of microspheres being appropriate to derive the required level of thermal insulation.

10. A thermally insulated underwater pipeline or group of pipelines according to claim 9 in which the jacket is of more rigid material or construction, typically steel,

11. A thermally insulated underwater pipeline or group of pipelines according to claims 9 and 10 in which the said jacket is an elongate jacket extending from adjacent one end to adjacent the other end of the pipeline or pipeline assembly, where the pipelines comprise a plurality of pipes joined end to end, in which each pipe is located within a surrounding elongate jacket, each jacket terminating short of each end of the respective pipe and each end of each jacket being secured to an end cap which circumferentially surrounds the respective pipe, each jacket being tightly packed with microspheres. The gap between adjacent jackets being filled with other material or fitted with a cover filled with microspheres.

12. A thermally insulated underwater pipeline or group of pipelines according to claims 9 to 11 in which said jacket comprises a plurity of elongate jackets which are abutted and adjoined to each other and if desired secured to bulkheads which circumferentially surround and if desired secured to the respective pipes.

13. A thermally insulated underwater pipeline or group of pipelines according to claims 9 to 12 in which the said jacket comprises a plurality of elongate steel jackets which are joined to each other by welding.

14. A thermally insulated underwater pipeline or group of pipelines according to claims 9 to 13 in which a layer of thermally insulating material surrounds said pipe and said microspheres are present between said thermally insulating material and the said jacket.

15. A thermally insulated underwater irregular shaped component such as a tee piece, branch connection, valve, all as aforesaid in claims 9 to 14 for pipelines.

16. A thermally insulated underwater pipeline or group of pipelines and irregular shaped equipment according to claims 9 to 16 in which the void space around and between the microspheres is filled with a liquid which will solidify or set to bond together the microspheres and to derive mechanical properties of an elastomeric

material. If desired the said end-caps may only be temporary and may be removed following filling of microsphere void space with bonding liquid.

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Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9217060.4
Relevant Technical Fields (i) UK Cl (Ed.L) F2G (G37); F2P (PC15) (ii) Int Cl (Ed.5) F16L	Search Examiner M Siddique Date of completion of Search 18 October 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-14,16

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1441208	(CONTINENTAL OIL) microspheres 18; jacket 2; resin etc	1,8,16
X	GB 1368665	(HEDLUND) page 2 lines 73-95, 43-47 etc	1,3,11
X	GB 1083185	(MEIER-SCHENK) Figure 2	1
X	GB 790490	(KENYON) pipeline 10; steel jacket 12; insulation 11; page 1 lines 45-47 etc	1,2 at least
X	GB 234535	(BOHLANDER) page 2 lines 38-43 etc	1 at least
X	EP 0059017 A	(WAVIN) see Figure 4	1,7,15
X	WO 88/08099 A1	(TIMPERT) packing 11; Figure 2 etc	1 at least
X	WO 84/00798 A1	(SCHREIER) particulate packing material 6 etc	1

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).